NT COOPERATION TREA

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Commissioner
US Department of Commerce
United States Patent and Trademark
Office, PCT
2011 South Clark Place Room
CP2/5C24
Arlington, VA 22202
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 20 February 2001 (20.02.01)	
International application No. PCT/EP00/04730	**Applicant's or agent's file reference** 4599/KH
International filing date (day/month/year) 24 May 2000 (24.05.00)	**Priority date** (day/month/year) 18 June 1999 (18.06.99)
Applicant LEFEVER, Ignace et al	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International Preliminary Examining Authority on:

23 December 2000 (23.12.00)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer Claudio Borton
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	**FOR FURTHER ACTION**	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
4599/KH		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/EP 00/ 04730	24/05/2000	18/06/1999
Applicant		
N.V. BEKAERT S.A. et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. **Basis of the report**

   a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

   [ ] the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

   b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

   [ ] contained in the international application in written form.

   [ ] filed together with the international application in computer readable form.

   [ ] furnished subsequently to this Authority in written form.

   [ ] furnished subsequently to this Authority in computer readble form.

   [ ] the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

   [ ] the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. [ ] **Certain claims were found unsearchable** (See Box I).

3. [ ] **Unity of invention is lacking** (see Box II).

4. With regard to the **title,**

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established by this Authority to read as follows:

5. With regard to the **abstract,**

   [X] the text is approved as submitted by the applicant.

   [ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No. 1

   [X] as suggested by the applicant.

   [ ] because the applicant failed to suggest a figure.

   [ ] because this figure better characterizes the invention.

   [ ] None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 00/04730

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B01D39/20 B01D46/24 F01K23/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B01D F01K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 94 14608 A (N.V. BEKAERT S.A.) 7 July 1994 (1994-07-07) page 3, line 33 -page 11, line 25 ---	1,2,5, 12-14
A	BE 1 008 484 A (N.V. BEKAERT S.A.) 7 May 1996 (1996-05-07) page 2, line 4 -page 7, line 34 ---	1,2,4,5, 12-14
A	EP 0 764 455 A (SINTOKOGIO, LTD. ET AL) 26 March 1997 (1997-03-26) page 3, line 30 -page 6, line 41; example 1 ---	1,2,7,8, 10,14
A	EP 0 572 063 A (SHELL INTERNATIONALE RESEARCH MAATSCHAPPIJ B. V.) 1 December 1993 (1993-12-01) the whole document --- -/--	1,14,15

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
8 August 2000	21/08/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Doolan, G

1

Form PCT/ISA/210 (second sheet) (July 1992)

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 667 467 A (ARCHER ET AL) 26 May 1987 (1987-05-26) column 2, line 25 -column 4, line 38	1,14,15
A	EP 0 515 124 A (THE BOC GROUP PLC) 25 November 1992 (1992-11-25) column 1, line 43 -column 6, line 14	1,14,15

INT[redacted]IONAL SEARCH REPORT

[redacted]mation on patent family members

[redacted]nal Application No
PCT/EP 00/04730

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9414608 A	07-07-1994	BE 1006452 A	30-08-1994
		AT 141080 T	15-08-1996
		AU 674369 B	19-12-1996
		AU 5555994 A	19-07-1994
		CA 2151477 A	07-07-1994
		CN 1089548 A,B	20-07-1994
		DE 69303932 D	12-09-1996
		DE 69303932 T	30-01-1997
		EP 0674582 A	04-10-1995
		ES 2092883 T	01-12-1996
		JP 8504692 T	21-05-1996
		US 5679441 A	21-10-1997
BE 1008484 A	07-05-1996	NONE	
EP 764455 A	26-03-1997	JP 9085027 A	31-03-1997
		JP 9085028 A	31-03-1997
		US 5800790 A	01-09-1998
EP 572063 A	01-12-1993	AU 3842193 A	25-11-1993
		CA 2095189 A	19-11-1993
		CN 1082453 A,B	23-02-1994
		DE 69304794 D	24-10-1996
		DE 69304794 T	27-02-1997
		DK 572063 T	07-10-1996
		ES 2092748 T	01-12-1996
		JP 6031123 A	08-02-1994
		SG 45277 A	16-01-1998
		US 5282877 A	01-02-1994
		ZA 9303409 A	15-11-1994
US 4667467 A	26-05-1987	DE 3618745 A	04-12-1986
		FI 862354 A,B,	05-12-1986
		JP 61283728 A	13-12-1986
		SE 462759 B	27-08-1990
		SE 8602461 A	05-12-1986
EP 515124 A	25-11-1992	AU 657326 B	09-03-1995
		AU 1710892 A	26-11-1992
		BR 9201933 A	12-01-1993
		CA 2069274 A	24-11-1992
		DE 69216471 D	20-02-1997
		DE 69216471 T	15-05-1997
		JP 5141265 A	08-06-1993
		MX 9202421 A	01-11-1992
		US 5437150 A	01-08-1995
		ZA 9203645 A	24-02-1993

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
4599/KH		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP00/04730	24/05/2000	18/06/1999
International Patent Classification (IPC) or national classification and IPC B01D39/20		
Applicant N.V. BEKAERT S.A. et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 5 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 3 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☒ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
23/12/2000	11.09.2001
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Smith-Hewitt, L Telephone No. +49 89 2399 2995

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/EP00/04730

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:
Description, pages:

1-13 as originally filed

Claims, No.:

1-14 as received on 11/06/2001 with letter of 01/06/2001

Drawings, sheets:

1/1 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-14
	No:	Claims	
Inventive step (IS)	Yes:	Claims	11
	No:	Claims	1-10, 12-14
Industrial applicability (IA)	Yes:	Claims	1-14
	No:	Claims	

2. Citations and explanations
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

1. Re: Item V

1.1 None of the available prior art documents discloses a system with all the features of the present claim 1. The subject matter of this claim and those claims dependent thereon (2-14) is therefore considered to be novel in the sense of Article 33(2) PCT.

1.2 Document D1 (EP-A-0.764.455) discloses all the features of the high temperature and corrosion filter required by the present claim 1. According to p.1, l.13-36 of D1, the filter of D1 was designed to overcome the problems associated with commonly available dust collecting equipment and with ceramic filters. The systems in which such problems occurred included, in addition to fixed type diesel engines, cogeneration systems, heat pumps and boilers. It is therefore maintained that the person skilled in the art of power generation would consider this document to be relevant when seeking a suitable filter for a plant such as that disclosed in D2 (US-A-4.667.467). Furthermore, p.5, l.19-20 of D1 states that 'good mechanical properties are shown at an operating temperature of 900°C or less. The filter would therefore be suitable for the operating temperatures encountered in coal fired power generation.

1.3 Document D2 stipulates the use of ceramic or metallic filters for removal of solids from a fuel gas (col.4, l.25-27), however does not describe suitable filters in more detail. The person skilled in the art would therefore be prompted to seek a suitable filter for this process in the available literature. As D1 discloses a metallic filter (the filter is made from metal fibres) which overcomes the problems associated with ceramic filters and which furthermore is applicable in the field of power generation, it would thus be obvious for said person to select such a filter for use in this application, thus arriving at the subject matter of the present claim 1. It is therefore maintained that the present claim 1 lacks an inventive step in the sense of Article 33(3) PCT. Claim 14 is not considered inventive for the same reasons.

1.4 Given the teaching of the available prior art and the scope of the skilled person, the additional features of dependent claims 2-10 and 12-13 do not appear to constitute inventive subject matter in the sense of Article 33(3) PCT.

1.5 A predominantly α-Al_2O_3 layer on the filter surface is not disclosed in D1. This

specific type of aluminium oxide layer offers good protection in the reducing atmosphere of the coal-fired power generation system. Neither the problems encountered with treating gases for this specific process (namely the reducing atmosphere encountered with coal-fired power generation), nor an immediately apparent solution to this problem are disclosed in the available prior art. It is therefore concluded that a combination of the scope of the present claims 1, 10 and 11 results in inventive subject matter in the sense of Article 33(3) PCT.

2. Re: Item VIII

2.1 Throughout the application, concentrations are cited in %, but neither weight nor moles are stipulated. This leads in particular to a lack of clarity of the claims (Article 6 PCT). However, as this definition is lacking throughout the entire application, it is not seen how this objection could have been overcome.

2.2 The term 'high', as in 'high temperature' (claim 1) is too vague (Article 6 PCT).

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
18 October 2001 (18.10.2001)

PCT

(10) International Publication Number
WO 01/78431 A1

(51) International Patent Classification[7]: H04Q 7/30

(21) International Application Number: PCT/FI01/00341

(22) International Filing Date: 6 April 2001 (06.04.2001)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
20000841 7 April 2000 (07.04.2000) FI

(71) Applicant *(for all designated States except US)*: **NOKIA CORPORATION** [FI/FI]; Keilalahdentie 4, FIN-02150 Espoo (FI).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **LATVA-AHO, Antti** [FI/GB]; 40 Eastwood Road, Bramley, Guilford, Greater London GU5 0DS (GB). **SUORANTA, Risto** [FI/FI]; Louhikonkatu 6, FIN-33730 Tampere (FI).

(74) Agent: **KOLSTER OY AB**; Iso Roobertinkatu 23, P.O. Box 148, FIN-00121 Helsinki (FI).

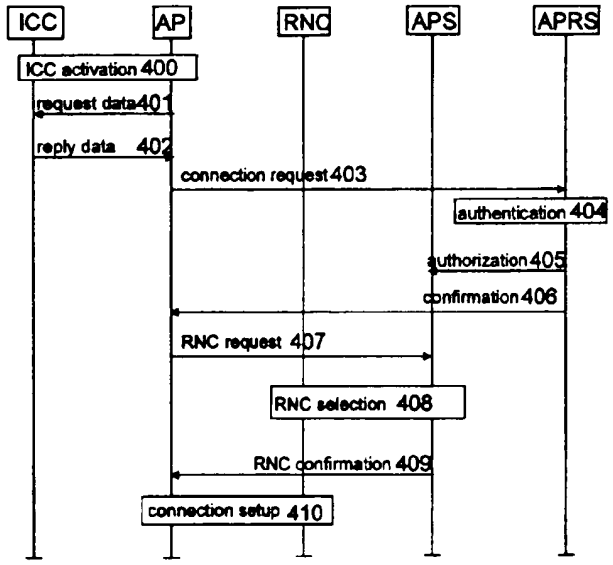
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AT (utility model), AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, CZ (utility model), DE, DE (utility model), DK, DK (utility model), DM, DZ, EE, EE (utility model), ES, FI, FI (utility model), GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SK (utility model), SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

(54) Title: CONNECTING ACCESS POINTS IN WIRELESS TELECOMMUNICATION SYSTEMS



(57) Abstract: A method of connecting an access point to other network elements in a wireless telecommunication system comprising at least one access point offering wireless connections, and at least one fixed network part. Data is stored on an IC card for connecting at least one access point to a functional connection with the fixed network part. The IC card is connected to a functional connection with the access point when the access point is to be connected to the fixed network part. Necessary resources of the fixed network part are connected to a functional connection with the access point on the basis of said stored data. As a precondition for the connection, the IC card's rights to use the resources of the fixed network part can be checked in the fixed network part.

WO 01/78431 A1

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 00/04730

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B01D39/20 B01D46/24 F01K23/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B01D F01K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 94 14608 A (N.V. BEKAERT S.A.) 7 July 1994 (1994-07-07) page 3, line 33 -page 11, line 25	1,2,5, 12-14
A	BE 1 008 484 A (N.V. BEKAERT S.A.) 7 May 1996 (1996-05-07) page 2, line 4 -page 7, line 34	1,2,4,5, 12-14
A	EP 0 764 455 A (SINTOKOGIO, LTD. ET AL) 26 March 1997 (1997-03-26) page 3, line 30 -page 6, line 41; example 1	1,2,7,8, 10,14
A	EP 0 572 063 A (SHELL INTERNATIONALE RESEARCH MAATSCHAPPIJ B. V.) 1 December 1993 (1993-12-01) the whole document	1,14,15

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
8 August 2000	21/08/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Doolan, G

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 00/04730

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 667 467 A (ARCHER ET AL) 26 May 1987 (1987-05-26) column 2, line 25 -column 4, line 38	1,14,15
A	EP 0 515 124 A (THE BOC GROUP PLC) 25 November 1992 (1992-11-25) column 1, line 43 -column 6, line 14	1,14,15

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/EP 00/04730

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 9414608 A	07-07-1994	BE 1006452 A	30-08-1994
		AT 141080 T	15-08-1996
		AU 674369 B	19-12-1996
		AU 5555994 A	19-07-1994
		CA 2151477 A	07-07-1994
		CN 1089548 A,B	20-07-1994
		DE 69303932 D	12-09-1996
		DE 69303932 T	30-01-1997
		EP 0674582 A	04-10-1995
		ES 2092883 T	01-12-1996
		JP 8504692 T	21-05-1996
		US 5679441 A	21-10-1997
BE 1008484 A	07-05-1996	NONE	
EP 764455 A	26-03-1997	JP 9085027 A	31-03-1997
		JP 9085028 A	31-03-1997
		US 5800790 A	01-09-1998
EP 572063 A	01-12-1993	AU 3842193 A	25-11-1993
		CA 2095189 A	19-11-1993
		CN 1082453 A,B	23-02-1994
		DE 69304794 D	24-10-1996
		DE 69304794 T	27-02-1997
		DK 572063 T	07-10-1996
		ES 2092748 T	01-12-1996
		JP 6031123 A	08-02-1994
		SG 45277 A	16-01-1998
		US 5282877 A	01-02-1994
		ZA 9303409 A	15-11-1994
US 4667467 A	26-05-1987	DE 3618745 A	04-12-1986
		FI 862354 A,B,	05-12-1986
		JP 61283728 A	13-12-1986
		SE 462759 B	27-08-1990
		SE 8602461 A	05-12-1986
EP 515124 A	25-11-1992	AU 657326 B	09-03-1995
		AU 1710892 A	26-11-1992
		BR 9201933 A	12-01-1993
		CA 2069274 A	24-11-1992
		DE 69216471 D	20-02-1997
		DE 69216471 T	15-05-1997
		JP 5141265 A	08-06-1993
		MX 9202421 A	01-11-1992
		US 5437150 A	01-08-1995
		ZA 9203645 A	24-02-1993

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
28 December 2000 (28.12.2000)

PCT

(10) International Publication Number
WO 00/78431 A1

(51) International Patent Classification[7]: B01D 39/20, 46/24, F01K 23/06

(21) International Application Number: PCT/EP00/04730

(22) International Filing Date: 24 May 2000 (24.05.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
99201951.3 18 June 1999 (18.06.1999) EP

(71) Applicant *(for all designated States except US)*: **N.V. BEKAERT S.A.** [BE/BE]; Bekaertstraat 2, B-8550 Zwevegem (BE).

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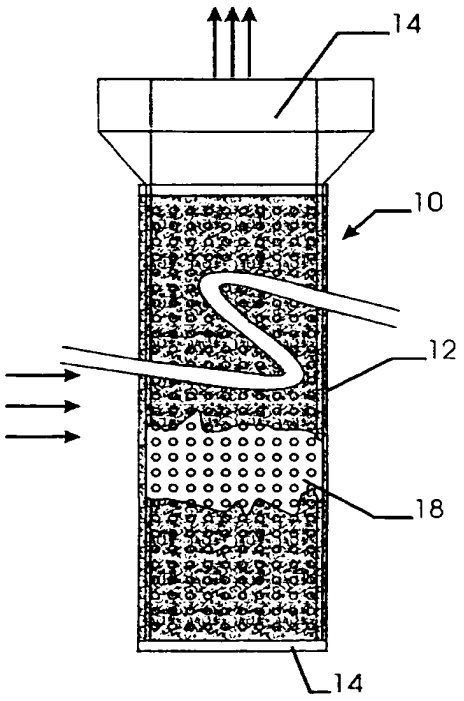
(54) Title: HOT GAS FILTRATION SYSTEM



(57) Abstract: A coal-fired power generation system comprises means for the production of coal-derived gas and a filter system for the filtration of this coal-derived gas. The filter system comprises at least one high temperature and corrosion resistant filter. The filter is made from a Fe-Cr-Al based alloy further comprising at least one additional element selected from the group consisting of Sc, Y, Ti, Zr, Hf, V, Nb, Ta and the lanthanides.

WO 00/78431 A1

HOT GAS FILTRATION SYSTEM

Field of the invention.

The invention relates to a hot gas filtration system comprising high temperature and corrosion resistant filters.

Background of the invention.

Hot gas filtration is for example used in the furnace exhaust of gases resulting from the combustion of fossil fuels. These fuels contain many impurities. Many filters have been used to reduce or eliminate the impurities in such furnace exhaust gases. However, there is still a need for improved filters which are capable of withstanding higher temperatures and pressures for removing particulates from hot combustion gases.

Especially in coal-fired power generation systems and more particularly in combined cycle power technologies, there is a big need for high temperature resistant and corrosion resistant filters. These technologies are based on the combustion and gasification of coal whereby the gas turbine is driven by the coal-derived gas.

Typical combined cycle power systems are pressurized fluidized bed combustor (PFBC) based systems, integrated gasification combined cycle (IGCC) based systems and hybrid cycle based systems. Some of these systems are already in operation, others are in development or at the demonstration stage.

A critical step in all these systems is the filtration of hot gases for the removal of particulates and other contaminants.

In these technologies, an effective and reliable hot gas filtration is of the utmost importance not only to meet the environmental emission requirements but also to protect the gas turbine components against fouling and erosion.

For such systems high performance, reliable hot gas filtration systems operating at high temperatures (200 – 900 °C) with a high corrosion resistance are required.

Particulates and contaminants such as sulfur, alkali metals and heavy metals have to be removed by the filter. Also the concentration of

hydrogen halides such as HCl and HF is preferably low to protect the components of the turbine. This can be a serious problem when high chlorine coals are gasified.
Up to now, the filtration of gases is a limiting factor for coal-fired combustion systems, because there are no filters which meet the above mentioned requirements.

Presently available filters for the filtration of hot gases are for example ceramic filters. A considerable drawback of this type of filters is their limited temperature range (250 – 450 °C) in which they can be operated. Ceramic filters also have the disadvantage that they suffer from thermal fatigue and high temperature corrosion, particularly in high temperature oxidising environments. The service life of ceramic filters is limited because the gas phase may react with the amorphous binder phase and because of oxidation of non-oxide based ceramics. Phase transitions may further put restrictions on the service life of such filters.
Still another drawback of ceramic filters is their limited shock resistance, either mechanical or thermal shock resistance. This can cause problems, for example during pulse cleaning.

An alternative for ceramic filters is the use of metallic filters. However, the known metallic filters feature the disadvantage that they are only suitable in reducing environments at low or intermediate temperatures (350 – 600 °C). When these filters are exposed to an oxidising environment, they suffer considerably from corrosion. Also impurities, such as sulfur or sulfur containing compounds or hydrogen halides may only be present in low concentrations in order to avoid corrosion.

WO 9532048 describes a filter comprising FeAl or $FeAl_3$ powder. The resistance is improved when a certain amount of Cr is added.

Summary of the invention.

It is an object of the present invention to avoid the drawbacks of the prior art.

It is another object to provide a coal-fired power generation system comprising a number of high temperature and corrosion resistant filters.

It is also an object to provide filters for such a system which can be used both in an oxidising or in a reducing atmosphere, which can withstand repeated temperature cycles and which has a high resistance against thermal and mechanical shocks.

Moreover, the invention aims to provide a system having a high filter performance, a high reliability and a long-term durability.

According to a first aspect of the present invention a coal-fired power generation system comprising means for the production of coal-derived gas and a filter system for the filtration of said coal-derived gas is provided.

The filter system comprises at least one high temperature and corrosion resistant filter. This filter comprises a filter medium and filter caps. The filter medium comprises at least one layer of metal fibers which has been sintered. Both the filter caps and the metal fibers are made from an iron-chromium-aluminium (Fe-Cr-Al) based alloy.

The diameter of the metal fibers is preferably between 4 and 30 µm, more preferably the diameter is between 8 µm and 22 µm.

The weight of the filter medium is preferably between 600 and 1500 g/m^2 and more preferably between 750 and 1200 g/m^2. The filter medium has a porosity between 60 and 85 % and preferably between 65 and 80 %.

In order to improve the resistance of the filter a protective Al_2O_3 layer may be formed on the surface of the filter medium and on the other elements being part of the filter. This protective layer may be obtained by preoxidising the filter.

In one embodiment the filter medium comprises a non-woven layer of metal fibers. The web is sintered and preferably compacted. In a further step, the sintered medium is welded to form the filter.

In another embodiment a filter medium comprising at least a first and a second layer is provided. Each layer comprises a web of metal fibers. The first layer, at the flow in side of the filter medium comprises metal fibers with a diameter between 4 and 12 µm. The diameter of the fibers of the second layer, this is the layer at the flow out side, is between 12 and 30 µm.

It is preferred that the weight of the first layer is between 20 and 60 % of the total weight of the filter medium. More preferably, the weight of the first layer is between 40 and 60 % of the total weight.

The first and second layer are brought into contact with each other to form a layered structure. This layered structure is sintered and compacted. In a subsequent step, the sintered and compacted filter medium is welded to form the filter.

In a preferred embodiment a mesh is fixed to the filter medium as a support layer.

The mesh may be fixed to the layer situated at the flow out side.

In an alternative way the mesh may be sandwiched between a first and a second layer of metal fibers.

The layered structure comprising the layer or layers of metal fibers and comprising the mesh is then sintered in a subsequent step.

As mentioned before, all components being part of the filter such as the metal fibers, the filter caps, and when a mesh is present also the mesh, are made from a Fe-Cr-Al based alloy.

A first group of Fe-Cr-Al based alloys comprises 15 to 25 % Cr and 4 to 6 % Al. Preferably the Al content is between 4.8 and 5.7 %.

A preferred alloy composition is a Fe-Cr-Al based alloy further comprising Y. This alloy is known as Fecralloy®.
The Y content ranges from 0.03 to 0.5 % and is preferably between 0.08 and 0.35 %. Most preferably, the Y content is between 0.25 and 0.35 %.
Another possible alloy composition of this group is a Fe-Cr-Al based alloy further comprising at least one additional element selected from the group consisting of Sc, Y, Ti, Zr, Hf, V, Nb, Ta and the lanthanides, for example La or Ce.
The content of the additional element or the sum of the additional elements is between 0.01 and 1%.

A second group of Fe-Cr-Al based alloys comprises up to 15 % Cr and 20 to 60 % Al. These alloys further comprise at least one additional element selected from the group consisting of Sc, Y, Ti, Zr, Hf, V, Nb, Ta and the lanthanides.

The Fe-Cr-Al based alloys show good corrosion resistance and high temperature resistance characteristics.
This resistance may further be improved by the presence of an oxide layer, more particularly an Al_2O_3 layer on the surface. Such a protective oxide layer limits the further oxidation of the metal since the oxygen can not diffuse through the Al_2O_3 layer. To obtain the desirable protection, a dense Al_2O_3 layer with a sufficient thickness is preferred.

During operation an oxide layer is formed spontaneously on the outside by oxidation of Al to Al_2O_3.
Alternatively, the alloy may be preoxidised under controlled conditions to form an Al_2O_3 protective layer. This preoxidation is preferably carried out in a furnace at a temperature between 1000 °C and 1200 °C and more preferably at a temperature between 1100 °C and 1200 °C.

Either in the case of the spontaneous oxidation or in the case of the controlled preoxidation, a protective Al_2O_3 layer is formed on the surface of the filter medium. However, the structure of the Al_2O_3 layer formed in the two situations is different : the spontaneous formed Al-oxide has a θ-structure, while the Al-oxide formed during the preoxidation step under the above mentioned conditions has predominantly an α-structure. By the term 'predominantly' is meant that there may be occasionally some defects. Although, when the oxide layer is formed at a temperature between 1100°C and 1200°C, the oxide layer shows almost no defects. This is in contrast with oxide layers formed at lower temperatures for example at 1000 °C, these oxide layers contain at least to some extent θ-Al_2O_3 and show much more defects. The quality of the Al_2O_3 layer further deteriorates when the oxidation is carried out at still lower temperatures.

The spontaneous formed Al_2O_3 (θ-form) has a rather porous structure. This oxide protection layer does not always give the material a sufficient protection, especially not in a reducing atmosphere or when the material is subjected to thermal cycles.

The α-Al_2O_3 on the contrary has a denser structure. Therefore, the α-form gives a much better protection, than the porous θ-form. This layer of α-Al_2O_3 is giving an excellent protection, even in a reducing atmosphere at high temperatures.

The alloy may show the tendency for the oxide to spall. The spalling can be a serious problem when the alloy is subjected to repeated thermal cycles. The spalling of the protective scale can however be limited and even be avoided when a certain amount of Y is added to the alloy. Therefore, a concentration of Y ranging from 0.03 % to 0.5 % is desired. More preferably, the Y concentration is between 0.25 % and 0.35 %.

Also the addition of traces of an element such as Sc, Y, Ti, Zr, Hf, Nb or a lanthanide improves the functional characteristics at high temperatures.

The filters may be flat filters, although candle filters and tubular filters are preferred.
A filter candle is a cylindrical tube with porous walls, closed at one end. Tubular filters are cylindrical tubes open at both ends.
A typical candle filter or tubular filter has an overall length between 1 and 2 m, for example 1.50 m, a wall thickness between 0.2 and 0.8 mm and an outside diameter of for example 60 mm.

Usually a filter system comprises a large number of filter elements, mostly arranged in multiple arrays. Typical numbers are 800, 1500 or 9600. The volume of the gas to be filtered and the filtration velocity achievable influences the necessary number of filter elements. The number of filter elements is different for the different technologies, such as IGCC or PFBC.

Filters comprising metal fibers furthermore have the advantage that they have a high resistance against thermal and mechanical shocks. The filters according to the invention may withstand frequent thermal cycles without problems.
The cleaning of metal filters is easier than the cleaning of for example ceramic filters or filters comprising metal powder. The filters may easily withstand repeated cleaning such as pulse cleaning. This results in filters having a long durability and a long service life.

A filter made from the above described Fe-Cr-Al based alloys withstands temperatures up to 1100 °C.

Because of the presence of a sufficient thick and dense Al_2O_3 protection layer, there is no considerable corrosion observed. The presence of Y avoids the spalling of the oxide.
The filter shows a good resistance in an oxidising environment at high temperatures, for example at 900 °C.
The desired resistance in a reducing environment at these high temperatures is obtained as well.

Since these filters may withstand the combustion temperature of coal, they may successfully be integrated in coal-fired power generation systems.
The filters are in particular suitable for the filtration of hot gases in pressurized fluidized bed combustor (PFBC) based systems, integrated gasification combined cycle (IGCC) based systems and hybrid cycle based systems.

According to a further aspect of the invention, a method whereby the yield of the coal-fired power generation system is increased, is provided. In a first step of this method a coal-derived gas is produced. This coal-derived gas is then filtered in a second step by means of a filter system comprising a number of the above described filters.
Since the filter may resist high temperatures, the filtration of the coal-derived gas may be carried out at temperatures up to 850 °C and even at higher temperatures, for example at 900 °C.

Because the filtration can be carried out at temperatures near the combustion temperature of coal, cooling of the gas before the filtration is superfluous. This results in a simplified installation and in a less expensive process.
Moreover the yield of the process is increased. Because of the high inlet temperatures to the turbine, IGCC and PFBC systems with efficiencies of over 40 %, for example over 45 % can be reached.

Because the pressure drop of the filter medium according to the invention is low, the necessary total filter surface of an installation is low. Accordingly, the number of filter elements is much lower than in the case conventional ceramic filters are used, which reduces the cost of the filter system.

As filters comprising metal fibers may withstand frequent thermal cycles, and as these filters may easily be cleaned, for example by pulse cleaning, the filters have a long service life. The frequency of replacement is thus considerably decreased, for example in comparison with ceramic filters or with filters comprising metal powder. This has a direct influence on the process and on the operational costs of production. After all replacing a filter medium is not only labour intensive but requires the interruption of the process and the cooling of the installation.

A high temperature and corrosion resistant filter may be manufactured by a method comprising the following steps :
providing a first layer of metal fibers;
if the filter medium comprises a second layer : providing a second layer of metal fibers and stacking up the first and second layer to form a layered structure;
sintering the first layer of metal fibers in the case there is only one layer or sintering the layered structure in the case there are more layers to form a sintered filter medium;
compacting the sintered filter medium;
welding the sintered and compacted filter medium to form the filter;
preoxidising the filter.

Preferably, the compacting step is done by means of a cold isostatic pressing operation.

In an alternative method, each web is sintered and compacted in advance. Thereafter, the different layers are stacked up to form a layered structure. The obtained layered structure is then sintered in a subsequent step.

A mesh may be fixed to the filter medium before the sintering of the obtained layered structure. The mesh may be fixed at the flow out side of the layer of metal fibers or at the flow out side of the layered structure comprising different layers of metal fibers.
In another embodiment the mesh is put in between a first and a second layer of metal fibers.

To improve the resistance of the filter, the filter may be preoxidised. This preoxidation step is preferably carried out in clean air at a temperature between 1000 °C and 1200 °C and more preferably between 1100 °C and 1200 °C. The duration of the preoxidation may vary from 15 minutes to 3 hours. Preference is given to a preoxidation time from 2 till 3 hours. To accelerate the formation of the Al_2O_3 layer and to improve the quality of the Al_2O_3 layer, oxygen enriched air can be introduced in the furnace in which the oxidation is carried out.

Brief description of the drawings.

The invention will be described into more detail with reference to the accompanying drawing wherein
FIGURE 1 shows a filter candle according to the invention.

Description of the preferred embodiments of the invention.

Referring to figure 1, a corrosion and high temperature resistant filter candle 10 is provided. All elements which are part of this filter candle, such as the filter medium 12 and the filter caps 14, are made from Fecralloy. The alloy comprises 0.30 % Y.

The filter medium is a layered structure comprising two layers. The filter medium may be supported, for example by a perforated tube 18.
The first layer is a web of fibers with a diameter of 12 µm. This first layer has a weight of 600 g/m².
The second layer is a web of fibers with a diameter of 22 µm. The weight of the second layer is 450 g/m².
The first and the second layer are brought into contact with each other and are sintered. The sintered filter medium is then compacted by a cold isostatic pressing operation.
The thus obtained filter medium has a weight of 1050 g/m², a thickness of 0.58 mm and a porosity of 77.26 %.
The sintered filter medium is welded to form the filter candle. The filter candle has an overall length of 1.50 m and an outside diameter of 60 mm.
In a subsequent step the filter is preoxidised to form an Al_2O_3 layer on the surface by putting the filter in a furnace at a temperature of 1100 °C during 2 hours.
In operation, the dirty gas flows through the filter medium from the outside to the inside of the candle. The clean gas leaves the candle through the opening. The direction of the gas flow is indicated by the arrows in figure 1.

The above described filter medium has been subjected to a conventional textest for measuring the air permeability and to a bubble point pressure test. The results are shown in table 1. They are compared with the results of two other similar filter media, the one having a porosity of 77.1 %, the other having a porosity of 62.1 %.
The tested filter media are all composed of two layers of metal fibers. The first layer comprises fibers with a diameter of 12 µm and has a weight of 600 g/m². The second layer comprises fibers with a diameter of 22 µm and has a weight of 450 g/m².

Table 1

	Medium 1	Medium 2	Medium 3
Weight (g/m²)	1050	1050	1050
Thickness (mm)	0.58	0.45	0.35
Global porosity (%)	77.26	77.1	62.1
Textest			
Average (liter/dm²)	260.67	141.00	70.33
at 200 Pa	(s = 6.02)	(s=13.62)	(s= 8.73)
Bubble point pressure test			
Average (Pa)	1547.50	1892.5	2210.0
Filter rating (µm)	33.91	19.55	16.74

To evaluate the temperature resistance and the behaviour of Fecralloy when subjected to thermal cycles, an aging test is carried out.

A medium comprising Fecralloy fibers is considered in this test.

The medium is first preoxidised at 1100 °C during 2 hours in a furnace.

By this preoxidation an Al_2O_3 layer was formed on the surface of the medium. XRD (X Ray diffraction) shows that the formed Al_2O_3 layer is α-Al_2O_3.

By scanning microscopy a considerable increase of Al at the surface of the fibers could be observed.

The medium was then subjected to an aging test during one month. The medium was thereby alternately exposed to heating and cooling cycles.

The heating periods take 8 minutes, the cooling intervals 2 minutes.

During heating the temperature rose up to 1080 °C.

After the test was carried out, the samples were evaluated by visual inspection and by scanning microscopy.

Scanning microscopy showed an increase of Al at the surface of the fibers.

No damage of the medium was observed after a test period of one month.

To evaluate the corrosion resistance, samples of sintered Fecralloy fibers with a diameter of 12 µm and samples of sintered Fecralloy fibers with a diameter of 22 µm are subjected to a corrosion test. The composition of the Fecralloy was as follows : 15.8 % Cr, 4.8 % Al, 0.3 % Y 0.03 % C, the balance is Fe.

Both preoxidised and non preoxidised Fecralloy samples were considered in the test. The preoxidation was carried out at 1100 °C during 15 minutes.

For the corrosion test, the samples were exposed during 1000 hours to the combustion atmosphere of a fuel containing 1 % S, resulting in a SO_2 content of 280 ppm. The temperature of the gas was about 600 °C.

In a first test there was no HCl present, in a second test 100 ppm HCl was added to the atmosphere. The samples were subjected every 24 hours to thermal cycles from room temperature to 600 °C.

The results of these samples were compared with samples comprising other sintered metal fibers such as AISI 310, Inconel® and Hastelloy® fibers, having the same diameters as the Fecralloy fibers, 12 µm and 22 µm.

After the corrosion test the degree of corrosion was evaluated by visual inspection of the samples, by comparison of the weight of the samples before and after the test and by the study of the results of optical microscopy.

The samples made of Fecralloy showed superior corrosion and heat resistance if compared with the other stainless steel samples.

When the non pretreated and the preoxidised Fecralloy samples were compared, the preoxidised samples showed the best resistance either in an environment containing HCl or in an environment without HCl.

XRD (X Ray diffraction) showed that the protective oxide layer formed on the surface of the preoxidised samples is α-Al_2O_3.

CLAIMS

1. A coal-fired power generation system comprising means for the production of coal-derived gas and a filter system for the filtration of said coal-derived gas, said filter system comprising at least one high temperature and corrosion resistant filter (10); said filter comprising a filter medium (12) and filter caps (14); said filter medium comprising at least one layer, said layer being a web of metal fibers which has been sintered, said filter caps and said metal fibers being made from a Fe-Cr-Al based alloy, said alloy having one of the following compositions
   - 15 to 25 % Cr, 4 to 6 % Al, at least one additional element selected from the group consisting of Sc, Y, Ti, Zr, Hf, V, Nb, Ta and the lanthanides, the remainder being Fe;
   - up to 15 % Cr, 20 to 60 % Al, at least one additional element selected from the group consisting of Sc, Y, Ti, Zr, Hf, V, Nb, Ta and the lanthanides, the remainder being Fe.

2. A system according to claim 1, whereby said metal fibers have a diameter between 4 µm and 30 µm.

3. A system according to claim 1, whereby said filter medium comprises at least a first layer and a second layer, said first layer comprises a web of metal fibers with a diameter between 4 µm and 12 µm, said second layer comprises a web of metal fibers with a diameter between 12 µm and 30 µm, the first and second layer are brought into contact with each other to form a layered structure, said layered structure is sintered.

4. A system according to claim 1 or 3, whereby the filter medium has a porosity between 60 and 85 %.

5. A system according to any one of claims 1 to 4, whereby a mesh is fixed to the filter medium at the flow out side, said mesh is made from a Fe-Cr-Al based alloy.

6. A system according to claim 3, whereby a mesh is sandwiched between the first and the second layer of metal fibers before the medium is sintered, said mesh is made from a Fe-Cr-Al based alloy.

7. A system according to any one of claims 1 to 6, whereby the additional element is Y with a concentration between 0.03 and 0.5 %.

8. A system according to claim 7, whereby the Y content ranges between 0.25 and 0.35 %.

9. A system according to any one of claims 1 to 6, whereby the sum of the additional elements is between 0.01 and 1 %.

10. A system according to any one of claims 1 to 9, whereby an Al_2O_3 layer is formed on the surface of said filter.

11. A system according to claim 10, whereby said Al_2O_3 layer is predominantly α-Al_2O_3.

12. A system according to any one of claims 1 to 11, whereby said filter is a candle filter or a tubular filter.

13. A system according to claim 12, whereby said system comprises a number of filters arranged in multiple arrays.

14. The use of a system according to any one of claims 1 to 13 for the filtration of hot gases up to temperatures higher than 850°C.

15. A method of increasing the yield of a coal-fired power generation system, said method comprising the steps of :
producing coal-derived gas;
filtering said coal-derived gas up to temperatures higher than 850 °C by means of a coal-fired power generation system according to any one of claims 1 to 13.

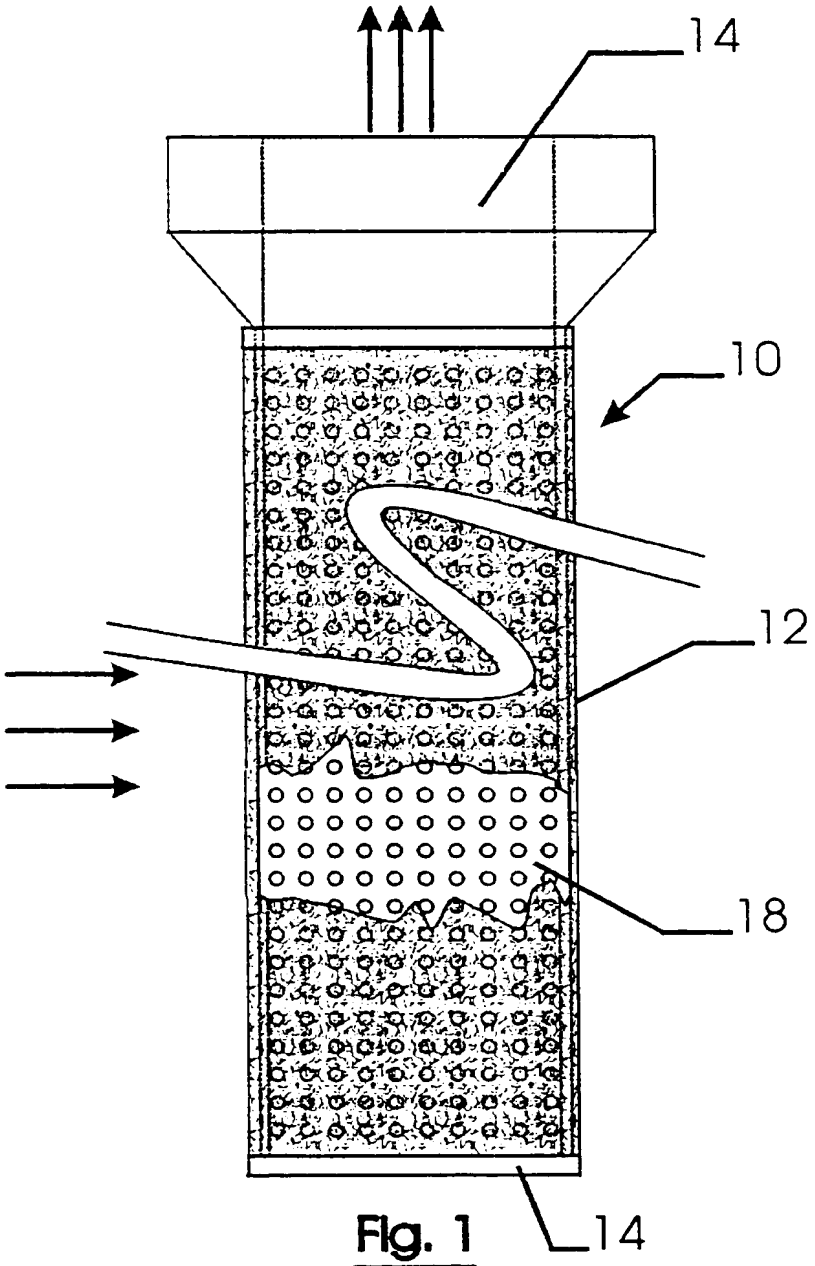


Fig. 1

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 00/04730

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B01D39/20 B01D46/24 F01K23/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B01D F01K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
8 August 2000	21/08/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Doolan, G

Form PCT/ISA/210 (second sheet) (July 1992)

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Information on patent family members

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